The PartnerWeb Project: A Component-Based Approach to Enterprise-Wide Information Integration and Dissemination

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A component-based health information resource, delivered on an intranet and the Internet, utilizing World Wide Web (WWW) technology, has been built to meet the needs of a large integrated delivery network (IDN). Called PartnerWeb, this resource is intended to provide a variety of health care and reference information to both practitioners and consumers/patients. The initial target audience has been providers. Content management for the numerous departments, divisions, and other organizational entities within the IDN is accomplished by a distributed authoring and editing environment. Structured entry using a set of form tools into databases facilitates consistency of information presentation, while empowering designated authors and editors in the various entities to be responsible for their own materials, but not requiring them to be technically skilled. Each form tool manages an encapsulated component. The output of each component can be a dynamically generated display on WWW platforms, or an appropriate interface to other presentation environments. The PartnerWeb project lays the foundation for both an internal and external communication infrastructure for the enterprise that can facilitate information dissemination.

INTRODUCTION

Community health information networks (or CHINs) are information technology-based networks that link health care stakeholders throughout a community.[1] Multiple, independent providers, payers, community agencies, and patients can use the network to exchange information with the goal of maintaining optimal health for all community residents. Such networks seek to facilitate communication, efficiency, access, and optimal use of health care resources. Although social and academic reasons may be the driving forces for the creation of CHINs, they have not lived up to their anticipated potential. It has been suggested that the root cause for their failure to thrive has been the lack of an overriding business objective.[2]

More recently, health care institutions themselves have sought to form *extended enterprises,* providing a comprehensive set of non-redundant, efficient services. The motivation has been to directly increase competitive business advantage and market share. This has led to the creation of integrated delivery networks (IDNs), which are cohesively linked from their inception and economically motivated. Inherently, an IDN requires the constituent health care enterprises to build a shared infrastructure that truly integrates communication and information. Computer-assisted communication can facilitate interaction between patients and providers, primary care physicians and specialists, ancillary services and providers, and other parties.[3] An information network which supports the extended enterprise of an IDN must be able to disseminate a multitude of diverse information, including: descriptions of institutional and provider services, locations of these services, means for gaining access to services (IDN-wide referrals), educational and research activities, distribution of policies and procedures, case management guidelines, and clinical decision support. Clinical data access, image distribution, a master patient index, and other functions can also be integrated into this network, once enterprise-wide security and confidentiality mechanisms are established.

Seamless integration of services is intended to reduce costs while maintaining patient satisfaction.[4] However, with respect to the information technology approach to achieving these goals, unless one is willing to introduce new systems for all functions for all participating organizational entities, an IDN is faced with the challenge of integrating extant information systems, currently running applications which were not designed to be integrated.[5]

Component-based software methods provide an attractive solution to this problem.[6] By allowing the construction of tools targeted at implementing specific services that can be used in many different ways, the component approach provides an architecture in which many different systems and disparate databases can be brought together into applications. Workstation applications based on components can integrate functionality seamlessly, and provide a consistent user interface.

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SETTING AND SCOPE

Partners HealthCare System was created in 1993 from the merger of two world-renowned hospitals—Brigham and Women's Hospital and Massachusetts General Hospital. With a growing number of affiliate practitioners and community resources, the goal is to become a comprehensive regional IDN for Eastern Massachusetts.

In 1996, Partners managed more than 100,000 inpatient admissions in the hospitals and over 2 million outpatient encounters.[7] As part of its overall vision to provide integrated health care delivery to the community at large, Partners needed to establish an easily accessible information resource for health care providers, patients, the general public, researchers and other colleagues which could serve as a means for internal and external communication. An approach was proposed by the Decision Systems Group (DSG), and the DSG was asked to develop this resource.

METHODS

The DSG approached this task by designing a World-Wide-Web (WWW)-based Internet and intranet application environment as its initial dissemination platform, using the DSG's component-based methodology for implementing specific services.[8] Because the WWW has become ubiquitous, WWW browsers provide a common client delivery method; furthermore, we can distribute information both internally and externally with the same methods, and with proper security in place, provide additional functionality to those clients for whom it is appropriate.

Specific services are implemented and updated by component-based tools. We have successfully utilized this approach in other projects where specific kinds of services required maintenance and revision.[8] By having separate components, the same functionality can later be used in other applications and delivered to other application environments besides the WWW.

The initial target audience has been health care providers, to be followed by a focus on health care consumers and patients. A basic set of information resources was identified for initial IDN-wide distribution:

- mission statements for the enterprise, for each hospital or other participating entity, and for each clinical and administrative department and division
- descriptions of the enterprise, each hospital or other entity, department and division—including organization, structure, and pointers to related information via a home page
- directories of clinical services and activities of each entity, department, and division
- administrative and organizational information, internal policies and procedures
- medical referral assistance to Partners HealthCare
- directory of participating physicians with profiles[10]
- IDN-wide event calendar
- institutional and departmental news and announcements
- area and institutional maps, including directions and parking
- telephone directories
- educational materials, programs and on-line learning resources developed at Partners
- research activities and faculty bibliographies
- links to other useful sites
- decision support information, including physician referral criteria and clinical practice guidelines

Instances of many of these resources have different ranges of intended distribution, which need to be specified when entered: e.g., a seminar event may be of interest only to the sponsoring department, whereas certain grand rounds events may be of interest Partners-wide; other items, such as particular news announcements, may be intended for the largest possible audience, including the general public. Items may need to have associated expiration or renewal dates.

Authority for entering, approving, and disseminating information needs to be managed, but the process is ideally carried out in a distributed fashion by the originators of the information, rather than by a central information systems organization. We used a strategy of distributed responsibility for authoring and editing, whereby each entity within the enterprise was responsible for its own content. All content resides in databases or is provided by specific tools, so that where appropriate, the content can be accessed and used in different contexts.

While the WWW is the initial delivery platform, we believed it important not to be tied to the limitations of the WWW-specific user interface. The information

resources need to be delivered through other application environments as well, e.g., the internal clinical system. Also, for the WWW, we wanted to be able to customize or alter appearance for particular classes of users, or to modify it over time, while at the same time fostering a consistent "look-and-feel" for information provided by the various entities. Thus, we adopted an approach to WWW access in which all content is delivered to the WWW server from components, and the WWW displays are dynamically generated.

To facilitate the entry, update, and maintenance of textual, template-based, or list-oriented content by a large and diverse group of people, with a wide range of computer knowledge and experience, in departments and divisions throughout the IDN, content-specific authoring and editing tools were built. Structured entry and editing of information could thereby be carried out with little or no computer training or prior knowledge.

RESULTS

The Editing System

Currently, the PartnerWeb editing system is comprised of 11 sets of forms for inputting and storing department text, list, and template-based content. These form systems include: general information, personnel, patient services, news, event calendar, educational materials, research, publications, training programs, outside links, and optional areas. Types of information captured by these forms may include: (1) basic information including telephone/fax numbers, hours of operation, office address, chief's name and title, welcome message, mission statement, and general focus of the entity; (2) descriptions of clinical activities, including procedures performed and clinics; (3) grand rounds, seminars, conferences; (4) specific news and announcements; (5) summaries of research activities and research groups; (6) biblio-

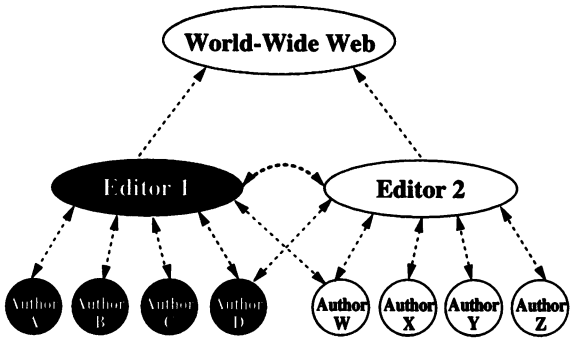

Figure 1—WWW Publishing Hierarchy

Table I—Summary of the Form Tool Systems Available in the Distributed Authoring and Editing Environment

Form System	Content	Example
General Information	General information about a department and who to contact with questions via electronic mail	Welcome message, mission statement, office address, hours of operations, telephone and fax numbers, chief's name and title, referral information, web contact name, faculty/staff listing
Event Calendar	Events that a department is sponsoring, or a series of events over a period of time	Grand rounds, lectures, lecture series calendar and information
News	Items of interest a department wants to distribute internally or to the public, department-specific newsletters and publications	Latest-breaking research news, a new clinical service being offered, grant awards, department newsletter, annual reports
Patient Services	Specific clinics or services of use to patients and physicians, individual service description, contact names with e-mail links	Department-specific patient care
Publications	Article, book, or book chapter citations with abstracts	Publications in print or pending release, written by members of the department
Training Programs	Available educational training programs within a department	Internships, fellowships, residencies, preceptorships
Educational Materials	Links to online educational resources that a department may offer	Online medical manuals or images, teaching case-of-the-week
Research	Ongoing research activities within a department	Research lab descriptions and information on project activities
Personnel	Personnel records for administrators and staff, research profiles of clinicians	Staff directory
Outside Links	World-Wide Web pages at other facilities, hospitals, research organizations, etc., that are relevant to a department	Specialty-specific sites at other hospitals, links to websites of professional organizations
Optional Areas	Any department-specific information that may not be applicable to other form systems	Directions to department offices/clinics, health tips, facility descriptions, etc.

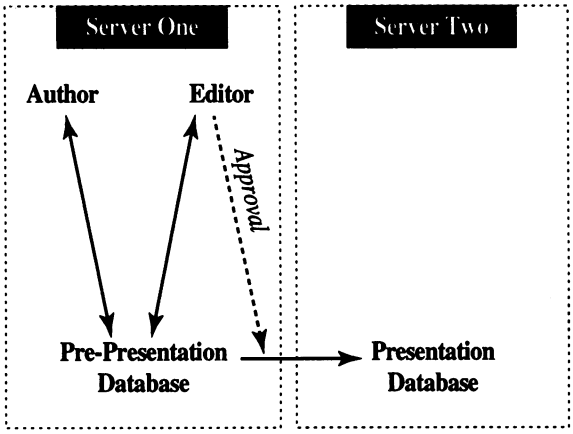

Figure 2—Database / Server Interaction

graphic references and on-line abstracts/articles; (7) faculty and staff profiles, photographs, and special interests; and (8) links to related WWW sites of interest. Table I summarizes each area along with examples. A number of other form sets are being developed.

The form tools are available on a server that can be accessed from any computer within Partners HealthCare that is Internet-capable. All text forms are currently WWW-based. The author/edit subsystem provides for management of privileges for authoring and editing for each entity in a hierarchical fashion. Two different levels of authorization are used for working with the form tools: authors and editors; together, they make up an editing group. Authors are able to enter content into the form systems to which they have been given access privileges. When finished, the editing system allows them to forward their work to an editor, who then reviews the material and decides whether to send it back to the author for changes, make changes him or herself, or publish it for distribution. The delegation of responsibilities and privileges is determined by each entity. Several authors can be defined to report to a single editor. An individual author may send her work to different editors, depending upon subject matter (see Figure 1). A designated person in the entity is given administrative authority to both establish and change authoring and editing privileges for that entity. This privileging function is also carried out through a form tool.

Authors have the ability to view what other authors within the entity have entered; however, they do not have the ability to change or delete information entered by other authors.

Database / Server Interaction

Two different database structures support PartnerWeb. All new information that are works-in-progress are put into pre-presentation databases. All previously entered materials that have been edited are stored here as well. When ready for distribution, the materials are moved to the presentation databases. The presentation databases are what the user views (see Figure 2.)

DISCUSSION

Tightly coupled information and communication systems are required for a truly integrated delivery network.[2] We have described a component-based solution, delivered on an intranet and on the Internet, using WWW technology to facilitate the objectives of the enterprise. Issues of data ownership, updating, and management are simplified by providing a distributed authoring environment, empowering individual entities with a means for structured entry, without the need for programming.

Each form system is designed to be an encapsulated component. Other types of content and tools can also be delivered through this approach, e.g., guidelines, image libraries, decision support, newsletters, journal articles—each with their own editing or development tools and implementation platforms. For example, tools may be HTML forms, Java applets, or plug-ins. We cannot overemphasize the value of a component-based approach: a primary motivation is being able to assemble needed resources for a particular user's need (e.g., problem-based or context-specific). Not only can the provided resources continue to grow and become more powerful, but also sophisticated layers can be added on top of component-based services, such as *information brokering* tools that function as mediators to automatically locate appropriate resources. An example, used in a specific subsystem of PartnerWeb for the radiology department at Brigham and Women's Hospital, called BrighamRad, is an information broker that can locate teaching file cases from libraries in distributed databases maintained by different institutions.[9]

A noteworthy aspect of PartnerWeb in terms of its value to users is the WWW-based physician directory,[10] which allows referring physicians to direct the patient's referral efficiently to the proper point within the Partners system. Using a search tool, a user is able to query this directory to obtain a profile, photograph, e-mail address, phone number, office address, and a list of clinical interests of a physician to whom a

patient referral is to be made, and may then initiate the referral.

The physician directory illustrates another characteristic of this kind of enterprise-wide design and development—that it can become a catalyst for change within the enterprise. In a number of circumstances, the process has identified new requirements and opportunities, and raised challenges for increased cooperation among the institutions. The physician directory reflects information fields used in a number of formerly totally disparate services, such as the telephone and paging directories, teleservices function, department/division staff listings, credentialing databases, and other functions. To coordinate and maintain a reliable up-to-date source for all these purposes requires cooperation among departments that previously viewed their own uses of the content entirely independently.

A long-term goal of this project is to enable primary care providers, specialists, patients, and the general public to obtain problem-specific guidelines and other educational resources, select required services, enter data, and send messages to colleagues or other health care providers. Based on security considerations that are still being evaluated, patient data will eventually be accessed via the same delivery platform or via communication with another network. To achieve this diversity of capability, applications will need to be built as compositions of distributed information resources and services. Both patients and providers will ultimately interact with a tool-based environment as a primary means of communication, information access, education, and decision support.

A consequence of the component-based architecture is that the tools developed are generic, enabling us to use them in a variety of other settings.

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